IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re patent application of
C. Leinemann
Serial No.10/559,761
Filed December 7, 2005
For PERMANENTLY FIREPROOF FLAMEGUARD

Confirmation No. 5937
Group Art Unit 3752
Examiner James Sean Hogan

Commissioner for Patents
PO Box 1450
Alexandria, Virginia 22313-1450

DECLARATION OF CHRISTOPH LEINEMANN AND THOMAS HEIDERMANN UNDER 37 C.F.R. §1.132

Christoph Leinemann declares as follows:

1. I received the degree of Master of Mechanical Engineering and Chemical Process Engineering from Technical University Carolo-Wilhelmina, Braunschweig, Germany, in 1989. Prior to receiving that degree in 1987, I participated on a student research project in the development of a hydraulic flame arrester at the firm of Braunschweiger Flammenfilter GmbH. That work led to German patent DE 680 984. After receiving my degree, during the period 1989–1990, I was a project engineer working at the firm of Keidelberger Kraftanlagen, Heidelburg, Germany, where I was responsible for projects at Sandoz, Switzerland. During the period 1990–1991, I worked for the Noell firm in Wuerzburg, Germany, in the department of "New Technologies" where I participated in the processing development of ground, water and air decontamination. This work led to numerous patents in which I was either a

sole or joint inventor. In 1992, I was Executive Assistant for the firm of Apparatebau Magdeburg GmbH, and from 1993–1997, I was Managing Director of that firm. There I was involved in the production of stainless steel vessels, reactors and flame arresters for the firm of Braunschweiger Flammenfilter GmbH, a 100% subsidiary of the firm of Braunschweiger Flammenfilter GmbH. While Managing Director, I participated in research and development projects for the firm based on my student research project and the development of a modular system for hydraulic flame arresters dia. 1, 2 and 3 m as well as type approval for explosion groups IIA, IIB3 and IIC in cooperation with the firm of IBExU GmbH, leading to a successful closing of the project in 1998. In 1997, I was given the additional position as the firm of Braunschweiger Flammenfilter GmbH of Director of R&D. In this capacity, I participated in various trials regarding the development of the European Standard for flame arresters, the development of various patents relating to this technology, and extension of the R& D center in Lehre. In January of 1999, I was made Assignment Technical Director and, as such, was the holder of general commercial power of attorney and responsible for the segments of engineering, technical processing of orders, design and R&D. In January of 2000, I was made Managing Director responsible for the segments technical department, production and procurement.

Thomas Heidermann declares as follows:

2. In 1991, I received the degree of Diplom-Chemist (dipl. chem.), from Georg-August-University, Göttingen, Germany. My Thesis was entitled "Investigation of the gas composition of burnt gas in premixed Ethylene-Air flames at high pressure". In 1995, I received the degree of Dr. rer. nat. in science (with distinction 'magna cum laude"), from Georg-August-University, Göttingen, Germany. My Thesis was entitled "Soot formation in high pressure flames". During the period

1991–1994, I was Scientific Assistant, Institut of Physical Chemistry, Georg-August-University Göttingen (chair Prof. Dr. Dr. H.Gg. Wagner). From 1994–1996, I was Assistant Professor, Institut of Physical Chemistry, Georg-August-University, Göttingen. From 1996–1997, I was Research Scientist, Max-Plank Institute for fluid dynamics, Göttingen. From 1997–1998, I was Senior Research Scientist, institute of Fluid Mechanics, Friedrich-Alexander University Erlangen-Nürnberg (chair Prof. Dr. Dr. F. Dust). From 1998–2000, I was General Manager of Engineering Company INVENT – Entwicklung neuer Technologien, Erlangen. Since 2000 I have held the position of Head of R&D Department, Braunschweiger Flammenfilter GmbH, Braunschweig. My publications include the following:

Heidermann, T., Rußbildung in vorgemischten Ethen-Luft-Flammen bei hohern Druck, Cuvillier-Verlag, 1995

T. Heidermann, D. Trimis, K. Lucka, F Dust et al, Der Porenbrenner für die Haushaltsfeuerung, 19. Deutscher Flammentag. VDI Berichte 1492, S. 623-628, Dresden, 1999 (Wilhelm-Jost-Award 2000 for the best paper presented by Flammentag)

Heidermann, T., Kuchta, H., Protection of the discharge pipe of a safety valve by using an end-of-line deflagration arrester, TÜ, (Vol. 11/12), 2003

Davies. M., Heidermann, T, In-line flame arresters to prevent flashback of thermal combustion Units, Process Safety Progress (Vol.26, No.1), 2007

Bosse, P. Davies, M.. Heidermann, Th,, Keeping explosion in isolation, hydrocarbon engineering, Dec.2008

Davies, M., Heidermann, Th., New ISO standard for flame arresters to increase explosion isolation efficient, HBC, 2009

Christoph Leinemann and Thomas Heidermann jointly declare as follows:

3. We have read and understand the above-identified patent application. Briefly described, the invention disclosed therein relates to invention is related to an endurance burning flame arrester characterized in its flow cross section being subdivided in a plurality of concentric annular sections arranged alternately without and with a large number of passage gaps. As shown, for example, in Figure 1, a housing 1 forms an annular enclosing cage for an annular flow cross section 2. The middle part 3 is left free by the housing 1. Two annular flame guard arrangements 4 are separated radially from each other by a concentric section 5. The flame guard arrangements 4 have passage gaps, while the concentric section 5 is formed without passage gaps and consists of a highly thermally conductive material, in particular metal. The flame guard arrangements 4, together with the flame guard insert 5, form a flame guard insert to the housing 1. Because of its solid construction, without passage gaps, the concentric section 5, with its good thermal dissipation, performs the function of cooling the flame guard sections 4. This prevents the flame guard sections 4 from heating up to such an extent that the ignition temperature for the gas flowing out is reached. This construction permits a flame guard with a larger flow cross section to be implemented without the risk of excessive heating of the flame guard sections 4.

4. We have read and understand the Office Action mailed December 4, 2008. The Examiner has rejected claims 1 to 8 on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1 to 9 of U.S. Patent No. 7,241,137 to Leinemann et al. and, in addition, rejected claims 1 to 8 under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 6,179,608 to Kraemer et al.

5. We have read and understand both U.S. Patent No. 7,241,137 to Leinemann et al. and U.S. Patent No. 6,179,608 to Kraemer et al. cited on by the Examiner.

6. Concerning the rejection of claims 1 to 8 on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1 to 9 of U.S. Patent No. 7,241,137 to Leinemann et al., it is our opinion that the Examiner is in error. Briefly described, the U.S. Patent 7,241,137 to Leinemann et al. is drawn to a flame arrestor having a disk structure comprising multiple concentric rings having two types of gas passages, wide (17) and narrow (18) and which are arranged in an alternate pattern in the radial direction (see Abstract, claim 1, and column 3, lines 56-60). The aim of this arrangement is that the narrower gas passages cause a higher flow velocity which results in increased cooling compared with the wider gas passages which guarantee a sufficient flow volume due to a smaller flow resistance but cause a lower flow velocity, thereby increasing the temperature. The flame burning at the end of the gap of the flame filter directly in contact with the filter represents the critical thermal load of a flame arrester for endurance burning. The gass velocity in the gap which causes this critical load is considered as critical velocity. However, the critical velocity depends on the width of the gap. If a flame filter has differently defined and particularly arranged gaps, the maximum thermal load only occurs either at the smaller or at the wider gaps, but never simultaneously. In comparison with conventional flame filters with equal gaps, the flame filter with defined different gaps is never loaded critically to its full extent. This leads to clearly improved flashback prevention at endurance burning. U.S. Patent 7,241,137 thus relies on proper matching between the two types of gaps which have different sized passages.

In contrast, the claimed invention is related to a permanent fireproof flame guard (often referred to as an "endurance burning flame arrester") claps gaps for the gas flow which are, in a radial direction, interrupted by at least one solid annular section having no gaps. A section having no gaps is quite different from a section having "smaller" gaps which cause higher flow velocity.

Thus, it should be clear that the ideas behind U.S. Patent 7,241,137 and the

present application are completely different because in a solid annular section without any gaps there can be no high flow velocity. In contrast to U.S. Patent 7,241,137, the section of the claimed invention having no gaps is used for cooling where the cooling effect is caused by the higher thermal conductivity of the material forming the annular section without gaps, e.g., solid metal. The so called "cooling ring" within the flame arrester is not able to contribute to the heating of the flame arrester element as the gas is not going through the cooling ring and therefore no flame can burn on it and heat it. The cooling ring draws the heat off the flame-faced filters with gaps on which the flame is burning. The cooling ring leads the drawn heat from the flame filter to the surrounding by convection and radiation. This energy discharge to the surrounding the cooling ring is able to absorb continuously used energy from the flame filter.

7. Concerning the rejection of claims 1 to 8 as anticipated by U.S. Patent No. 6,179,608 to Kraemer et al., in our opinion, the Examiner is in error. Kraemer et al. disclose a swirl velocity component with an integral flashback arresting capability which is made of two pieces, i.e., multiple channel monoliths which can be configured differently and are made as an assembly or as two parts with a gap between both. These structural features make the Kraemer et al. device different from the claimed device. Further, nowhere is the flow cross section of the Kraemer et al. device (see Figures 1 and 3) shown to be configured with at least one solid annular section without passage gaps on both sides of which are annular sections having passage gaps as is required in claim 1. For this reason, claim 1 and all of its dependent claims are not anticipated by Kraemer. In addition, with reference to claim 2, it is erroneous to conclude the Kraemer et al. device shows the cross sectional area with the passage gaps being greater than the cross-sectional area without passage gaps since nowhere in Kramer et al. is there shown an annular section without the passage gaps. Similarly, with respect to claims 5, since Kraemer lacks an annular section without passage gaps, it also lacks a plurality of annular sections without passage

gaps. With respect to claim 3, Kraemer does not show both a solid core and an annular section with no passage gaps.

With reference to page 4 of the Office Action, the Examiner states at the top of the page that Kraemer et al. has "at least one concentric annular section (60, and the solid-line separations between each concentric gapped ring) is formed so as to be solid without the passage gaps, and regardless of size *would* dissipate heat in the concentric region within the flow section" (emphasis the Examiner's). The Examiner in commenting on claim 4 states that "Kraemer et al discloses that the concentric section (60) is formed *possibly of a highly thermally conductive material*" (emphasis added), citing column 8, lines 11 and 12. Then, in his comments with respect to claim 5, the Examiner states "shown in Figure 5 [of Kraemer et al.] is a plurality of annular sections are provided as concentric sections (75), which, although not drawn to any significant gauges, are solid, which are, in each case followed in the radial direction by flame guard arrangements with passage gaps (21)."

It is obviously wrong to refer to hub 60 as a solid annular section in the sense of claim1 because there is no annular section with passage gaps on both sides of hub 60. It is also obviously a misrepresentation of the hub 60 as "possibly of a highly thermally conductive material", since the correct quote at column 8, lines 11 and 12 is "A solid hub is fabricated from solid round stock of an appropriate material" (emphasis added). Moreover, at line 44 of column 8, the hub 60 is described as being "optional". Obviously, there is an annular section with passage gaps only on one side, namely radially outwards from hub 60. Additionally, the Examiner referred to the solid-line separations 75 (see Figure 3) between each concentric gap ring of Kraemer et al., suggesting that these might be interpreted as solid annular sections. The solid-line separations 75 represent the smooth band which is in a usual way spirally wound up together with a corrugated band (76) in order to produce the well-known flame arrester having the flame extinguishing gaps. The smooth band (75) is necessary for

establishing gaps of a defined size. Therefore, the smooth band is part of the gaps which cannot be performed in a stable and well-defined manner by the corrugated band without the smooth band. Therefore, it is not possible to regard the smooth band as a concentric solid annular section having no passage gaps. With respect to claim 6, there is no suggestion in Kraemer to wind the smooth metal strip directly, i.e., without the intermediate corrugated strip, on itself, in order to perform the annular concentric section without gaps by means of several windings of the smooth strip or band.

8. A key feature of the claimed invention is the provision of at least one concentric section of highly thermally conductive material that subdivides the flow cross section into a plurality of annular flow areas. This concentric section is formed as a solid without passage gaps and serves to limit impermissible heating in the radial inner region of the flame guard. In the years 2002 and 2003, we performed at the test facility of Braunschweiger Flammenfilter endurance burning tests according to the European flame arrester standard EN 12874 for explosion group IIA. The aim of these investigations was to check the influence of filter gap size in combustion with cooling systems, like full metal rings, heat pipes and U-profilers. An end-of-the line flame arrester which is endurance burn proof has to fulfill the requirements given by the European standard or nowadays by the International standard ISO 16852. After a heat up phase, the fame arrester shall withstand the flame at least 2 hours without any flash back or flame transmission. A flashback shows that the design of the flame arrester is insufficient. In Table 1, four different designs of filter gap size, cooling system and the testing results are given. In test No. 1 (see Fig. 1), a flame arrester with three burning areas and three full metal cooling rings is given. The filter gap size was 0.5 mm. By stopping the flow of the fresh gas, the flame arrester failed.

											Cool Rings		V	Result
Date	No.	d_1	D_1	d_2	D_2	d_3	D_3	H	D_a	SW	number	kind	[m³/h]	
23.05.2002	*1*	136	180	250	294	364	408	50	460	0,5	3	full	47	flashback
19.08.2002	*3*	125	180	240	294	354	409	50	470	0,5	3 + pipes	U-Profile	58/85/27	o.k.
30.09.2002	*4*	136	408	-	-	-	-	50	460	050303	0		83	flashback
05.02.2003	*6*	125	224	305	408	-	-	50	470	050303	2	U-Profile	57/28/85	o.k.

Table 1: test conditions and geometric factors of end-of line flame arresters

In test No. 3, we used a gap size of 0.5 mm and three U-profiles for cooling and in addition a lot of radial pipes (see Fig. 2). No flashback was observed. This flame arrester showed the most effective cooling system of all tests. Flame arrester test No. 4 (see Fig. 5) was made with a full filter element using gap size 05/03/03. By shut off of the flow, the arrester failed. In Test No. 6 (see Fig. 6), we used a flame arrester with two flame areas, a U-profile cooling system and a filter gap size of 05/03/03. This flame arrester worked under all conditions and avoided any flashback. It is the optimum of cooling efficiency and flow capacity respectively gap size. To get a better understanding of heat accumulation and heat flux, we used in test No. 3 and infrared camera (see Fig. 3). The pictures show an effective temperature sink at the U-profiles. Additionally, the temperature profile across the flame arrester surface (see Fig. 4) documented the influence of the cooler; it is cooling at a high temperature level, bu important for the function of the flame arrester.

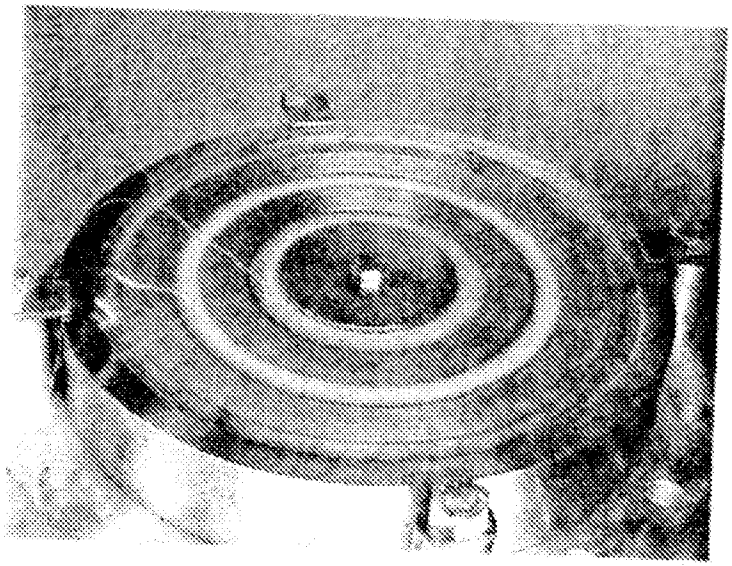

Figure 1: Test No. 1: full metal cooling unit (3 rings) and a gap size of 0.5 mm

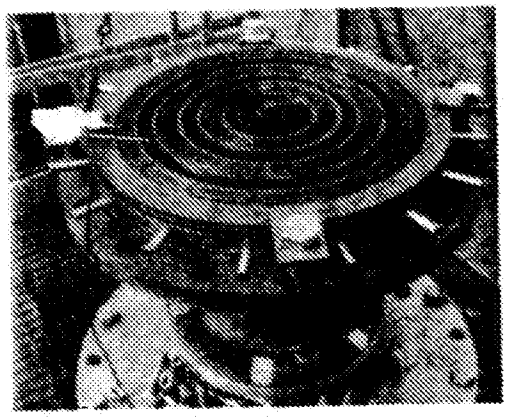

Figure 2: Test No. 3: U-profiles and radial cool pipes

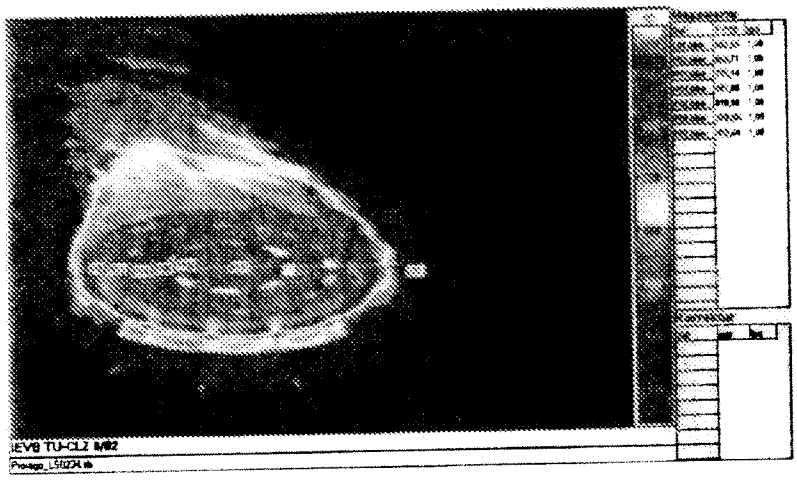

Figure 3: Infrared picture of flame arrester test # 3

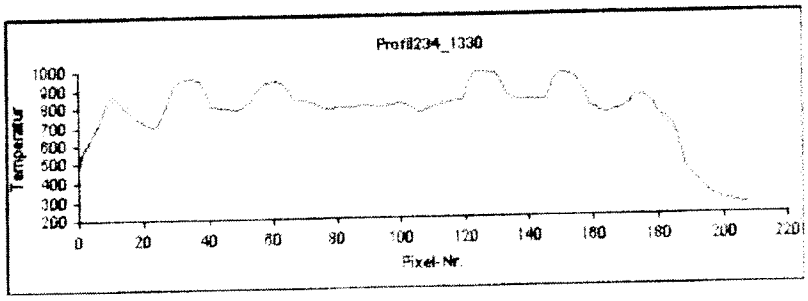

Figure 4: Temperature profile across flame arrester surface

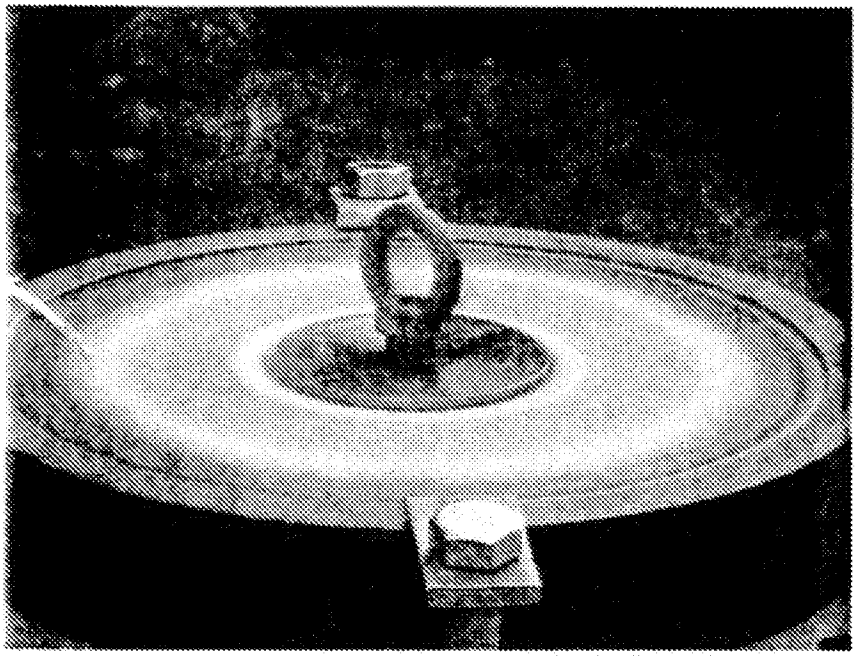

Figure 5: Test No. 4: no cooling rings and gap size 05/03/03

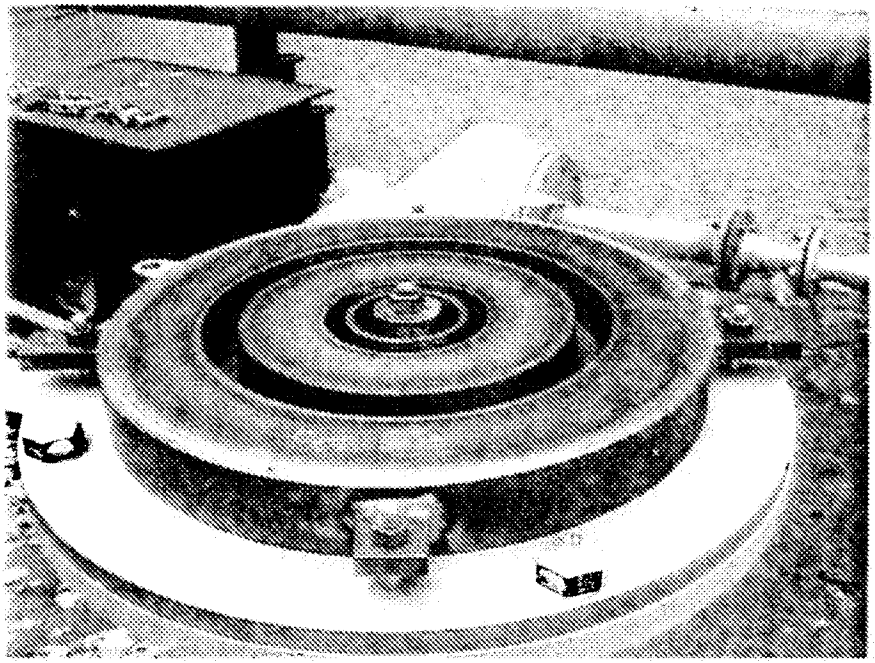

Figure 6: Test No. 6: U-profiles and a gap size of 05/03/03

9. We hereby declare that all statements made herein of our own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

June 03/2009
Date

Christoph Leinemann

May 21, 2009
Date

Thomas Heidermann